Simon Fraser University

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Final Project

Vancouver Housing and Stock Market Comparison

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Contents

1 Introduction

1.1 Scope

1.1.1 Investment Value of a Real Estate Property

The intent of this project was to show the investment value of a real estate property that is directly being used by the investor to live in. It is quite easy to compare the basic investment value of a real estate property by looking at its purchase and selling price. However, most people that purchase a real estate property do not use it solely as an investment but also as a place to live. To see the actual return on a real estate property it is essential to include living expenses such as mortgage expenses, opening and closing costs, insurance, etc. Furthermore, all calculations are based on past performances.

1.1.2 Buy vs Rent

A further intent was to compare the investment value of a real estate property with a financial investment at the stock market. I wanted to answer the question of whether it is more feasible to put a down payment on a house or apartment and pay a mortgage or use the down payment instead to invest in stocks and pay rent.

1.1.3 Annualized Rate of Return

The annualized rate of return is the main measure that is being used in my visualizations. This rate provides information about an investment's performance over multiple years and its consistency. Furthermore, all visualizations (except the line chart) show the annualized rate of return at the simulated sale as this rate is most accurate at the end. However, the line chart shows the annualized rate for each year as this chart intents to show how an investment progresses over time.

1.2 Users/Audience

My audience consists of two different stakeholders. The first stakeholders are people considering purchasing a real estate property to live in but at the same time want to use it as an investment property. This audience is interested in knowing the neighborhoods with the best increase in value over time. Furthermore, this audience will also have to decide whether they should buy a house or an apartment, the number of bedrooms, as well as the size of the down payment.

The second stakeholders are people that are more financially versed. They are open to forgo buying a real estate property and rent instead, therefore allowing them to invest more heavily in the stock market. For a fair comparison between buying and renting my calculations are based on investing in the stock market with a maxed-out margin loan. This means the investor must be open to accept a certain amount of risk just as they would with buying a mortgage.

2   Problem/Domain Questions

2.1.1   Investment Value of a Real Estate Property

The audience will be able to answer the following questions:

- Which neighborhood has the best return on investment?
- Which down payment percentage has the best return on investment?
- Which number of bedrooms has the best return on investment?
- Which housing type (apartment, single, two or multiple family dwelling) has the best return on investment?
- Does Strata or Non-Strata have a better return on investment?
- Which combination of the above category has the best return of investment?
- What is the distribution of properties in Vancouver? E. g. where can I find most 2-bedroom apartments?
- Where and what kind of properties are currently being sold?

2.1.2   Buy vs Rent

For people deciding on whether to buy or invest they will have the same question as the previous audience. However, in addition they want to be able to compare the investment value of a real estate property versus the stock market:

- Which combination of rest estate characteristics will have the highest return?
- How does the real estate market fare against the overall stock market?
- How does the real estate market fare against particularly low or high-risk stocks?
- How does the real estate market fare against brand value names on the stock market?

3   Data

3.1.1   Property Data

This is the main data set with the individual property information including assessed value comes from the yearly Vancouver tax assessment (Vancouver Open Data):

3.1.1.1   Dimensions:

PID, Strata or Non-Strata, Dwelling Type (family dwelling or condo), Address, Neighborhood, Land Value, Property Value, Tax Costs, Tax Report Year, Build Year

3.1.1.2   Filters on Data Set:

Dwelling Type: only 'One Family Dwelling', 'Multiple Family Dwelling', 'Comprehensive Development', 'Two Family Dwelling'

Report Year: 2015 to 2020

3.1.2   Number of bedrooms

Because the Vancouver tax assessment data does not include any information about the number of bedrooms a property has, I needed to derive this information. (Zolo) provides the detailed sale information for different housing types as well as number of bedrooms for 2019. With the average sale price for 2019 I was able to estimate a property's number of bedrooms by comparing its assessed value to the average sale price by housing type. This would serve as my baseline. I then used the (MLS HPI) (Home Price Index) that shows the progress of the sale prices for the different housing types from 2005 to 2020. Using this index, I further estimated each property's number of bedrooms for all the other years.

3.1.3   Residential Properties

The Vancouver tax assessment considers condos as part of the type "Comprehensive Development". However, properties in this category can be residential, commercial, or even parking spots. The Vancouver tax assessment data does not provide any other information to distinguish between these two types. However, for this project I only wanted to include residential properties. For this reason, I filtered out any "Comprehensive Development" properties that are less than 75% or more than 250% of the average sale price (by number of bedrooms) by year.

3.1.4   Strata Fees

Many online sources state the average Strata fees in general by square feet. However, the Vancouver tax assessment data does not provide the square footage information. Therefore, I explored a few Vancouver properties on Rew.ca and used the average Strata fees by the advertised purchase price which came out to 0.5013%

3.1.5   Maintenance Fees

According to (Ratehub) yearly maintenance fees are between of 3% to 5% of the property value. Therefore, I added 4% of the assessed property value to the yearly cost of ownership. However, for Strata type properties I only added half of these maintenance fees because some of these fees will already be covered by their Strata fees.

3.1.6   Opening Costs

In the year that the real estate property was simulated to be purchased, I added 1% to the yearly owner's costs to make up for any legal fees or administrative costs associated with the purchase.

3.1.7   Closing Costs

In the year that the real estate property was simulated to be sold, I added 5% to the yearly owner's costs to make up for any commissions, legal fees or administrative costs associated with the purchase.

3.1.8 Homeowner's Insurance

(Insureye) provides the average homeowner's monthly insurance based on the property value for British Columbia:

Property value	Average monthly homeowner's insurance cost
0 to 100k	$43
100k to 300k	$51
300k to 700k	$87
700k to 1.5M	$130
1.5M to 5M	$155
5M and up	$300

I assigned the above costs as yearly fees to each property based on their assessed value.

3.1.9 Renter's Insurance

(Insureye) states that the average renter's insurance in British Columbia is $26 per month. Therefore, I multiplied this number by 12 to calculate the renter's insurance of a property.

3.1.10 Renting prices

(The Canada Mortgage and Housing Corporation) provides the median Vancouver rent price data by neighborhood and number of bedrooms for each year from 2006 to 2019. With this information I am assigning each property an estimated price a person would have to pay to rent it.

3.1.11 Arbitrary Properties for Sale

3.1.11.1 Vancouver Addresses

(The Integrated Cadastral Information Society ICIS) provides the geolocation (latitude and longitude) of many addresses in Vancouver. Every property in the Vancouver tax assessment dataset comes with an address. Combining these two datasets gives each property a geolocation information.

3.1.11.2 Random Selection

Because I did not have any dataset on the current properties on sale In Vancouver, I randomly selected around 1% of all the properties included in this project to be on sale. There is no meaning or logic behind the 1% mark but rather a value that provides enough properties for demonstration purposes. However, for newer properties I raised this 1% mark to have more data points available in the prototype.

3.1.12 Mortgage Costs

The (Government of Canada Statistics) records the conventional 5-year fixed mortgage lending rate from 2000 until 2020. I calculated the mortgage costs as follows:

Example:

Year of Purchase: 2010

Assessed value of the property: 500,000

Down payment: 20%

➔ Loan: 400,000

I would use the conventional mortgage rate from 2010 and apply for the next 5 years from 2010 until 2014 on the loan amount of 400,000 that was taken out. Then after 5 years I would use the conventional mortgage rate from 2015 and apply it for the next 5 years from 2015 to 2019 on the amount that was remaining. The remaining loan amount was equal to the initial loan of 320,000 minus the principal that was paid over the previous 5 years. These calculations would give a very good estimate of the actual mortgage for each property.

3.1.13 Stock Returns

I selected the following stocks from (Yahoo Finance) and used their yearly returns: Apple, Facebook, S&P500, and Gold

3.1.14 Margin Rates

The Investment Industry Regulatory Organization of Canada (IIROC) states that the margin requirement is 70%.

Furthermore, there are no historic average interest rates for margin loans in Canada. However, the average margin rate is currently around 5% when looking at the rates of several online brokers. I therefore used 70% as the margin requirement and a 5% interest for the margin loan when investing in stocks for any year.

3.1.15 Stock Market Transactional Costs

Because any transactions incurred from the stock market are very minimal in comparison, I did not include these fees. Furthermore, the scope of this project was for savvy investment people that do not require a financial planner. However, if a financial planner would be involved then their fees would need to be included in the calculations.

3.1.16 Annualized Rates

For the mortgage and stock returns I calculated the annualized rate which is the overall yearly rate of return on an investment over multiple years.

3.1.17 Vancouver Shapefile

The 30 neighborhoods in the Vancouver tax assessment data differ from the usual neighborhoods in Vancouver. I therefore had to manually draw each individual neighborhood as seen on an (Arcgis) map in (Tableau Drawing Tool) to obtain its geographic coordinates.

I then laid these geographic coordinates on a Vancouver layer from (The Integrated Cadastral Information Society ICIS) in (GQIS) to create a polygon for each of the 30 Vancouver tax assessment neighborhoods.

4   Visualization Design

4.1   Overview Dashboard

This dashboard is the main aspect of my project and contains most of the visualizations.

4.1.1   Map

As the very first plot I chose a map to show an overview of the annualized rate of return for all neighborhoods in Vancouver. I assigned a green background color to neighborhoods with a positive return and a red background to neighborhoods with a negative return. Furthermore, neighborhoods with larger returns (positive and negative) have a higher saturation whereas neighborhoods with returns closer to 0 have a lighter saturation.

In addition to the visual aspect, the map also comes in handy for the selection of specific neighborhoods. Any selection in this map has a direct effect on all the other visualizations on this dashboard as every chart is connected.
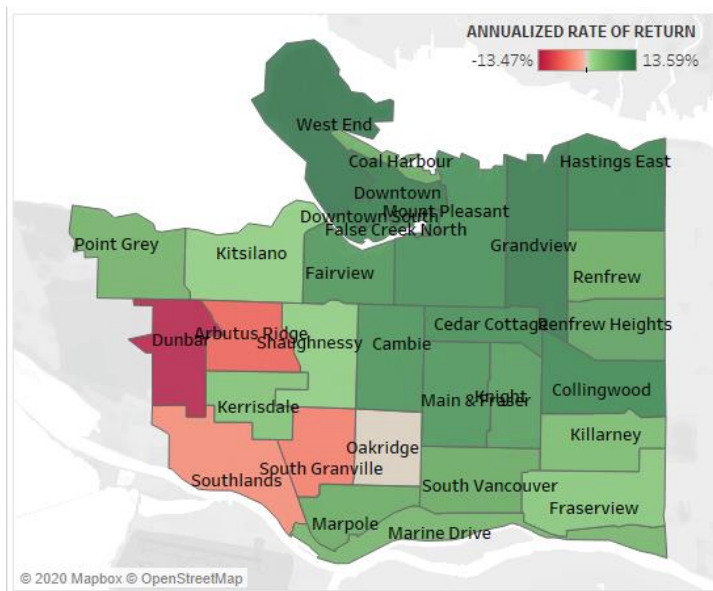
4.1.2   Progress Line Chart

Once a selection is made for one or multiple neighborhoods in the map, the annualized rate of return is shown for each neighborhood in the line chart next to the map. Also, the same line chart contains the annualized rate of return of several stocks such as Apple, Facebook, S&P500, and Gold. Putting these measures all together in a line chart provides the opportunity to compare the progress of each over the span of the ownership in years. I tried making the lines for the neighborhoods and the lines for the stocks more distinguishable. However, Tableau does not support dashed or dotted lines as a standard. Therefore, I kept the lines for the stocks in simple black to differentiate them from the housing lines.

Furthermore, using a line chart an analyst can quickly see the fluctuation of a single investment (housing or stock market). If the fluctuation is too high, then they may consider that type of investment too risky and would prefer an investment with a steady and constant rate.

The data behind this chart contains a starting year (simulated purchase), ending year (simulated sale) and a report year which is the year of the tax assessment. The starting and ending year are the filters that need to be selected as there are multiple options for these years and these options do not work concurrently. The line chart however shows the progress along the report year which is why further brushing or brushing the report years within the chart is not an option. The annualized rate of return for all the other visualizations are based on the ending year, and therefore making a filter on the report year would have no effect.
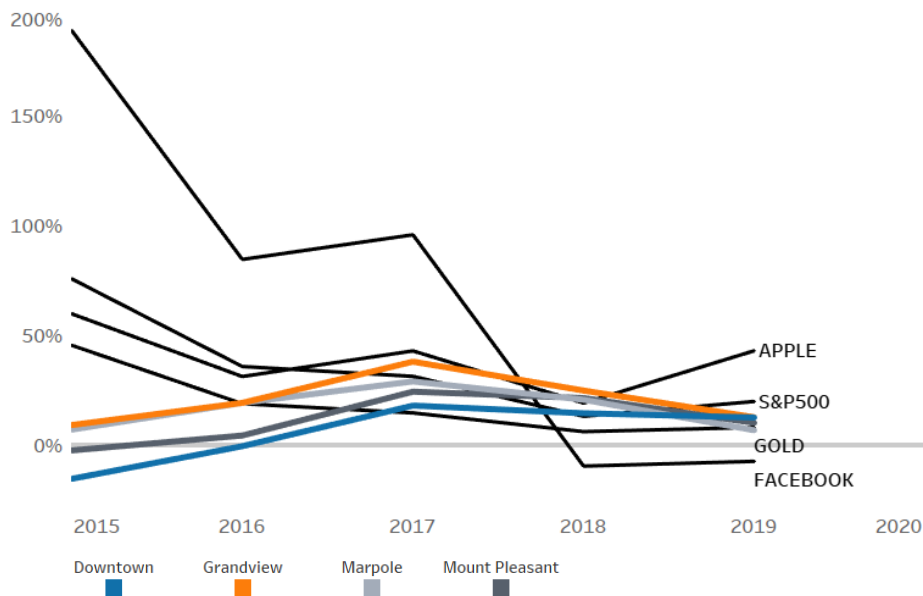
4.1.3 Neighborhoods, Down Payment, Legal Type, # of Bedrooms, Zone Category, Dwelling Type

The remaining visualizations in the overview dashboard are all made as a bar chart. The purpose of these visualizations is to provide a comparison of the annualized rate of return for different categories. Because a comparison of the rate at the ending year makes most sense, there is no need for a progress such as a line chart. For that reason, a bar chart worked best for the comparison of a single value.
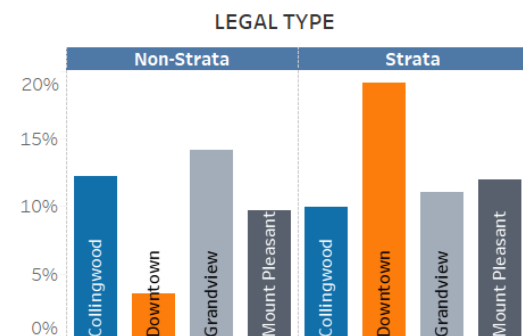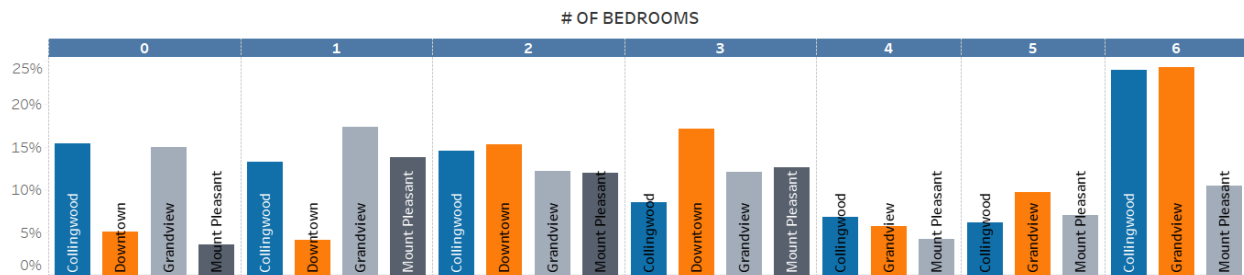
4.1.3.1 Neighborhoods
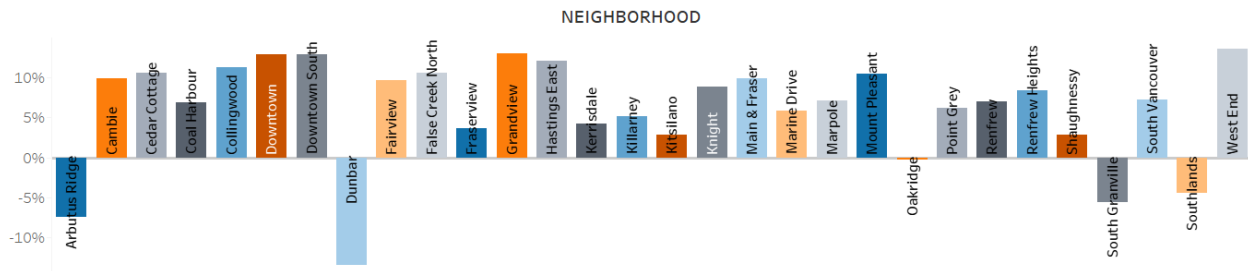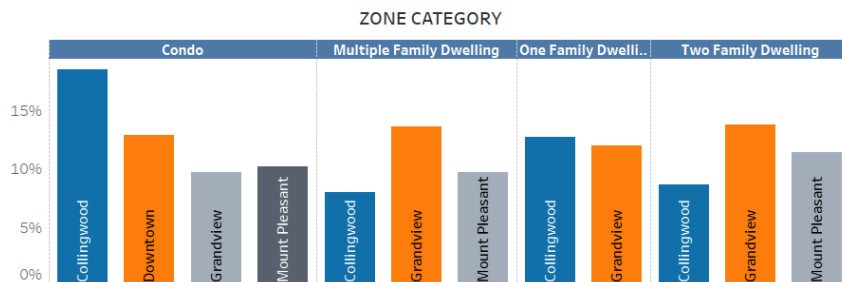

4.1.3.2 Down Payment
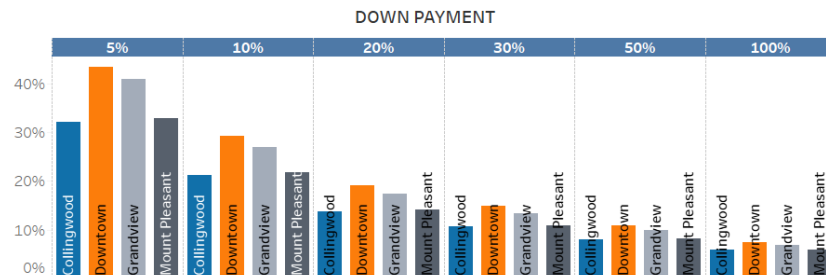
4.1.3.3 Legal Type
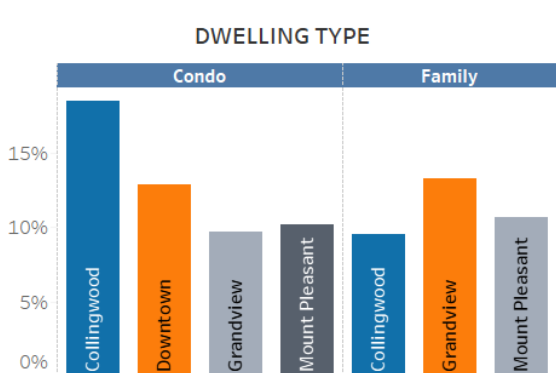
4.1.3.4   # of Bedrooms

4.1.3.5   Zone Category

4.1.3.6   Dwelling Type

4.1.4   Interactions

As mentioned earlier, all visualizations on this dashboard are connected, and the order of the charts is built logically. First the user will select one ore multiple neighborhoods. Then it makes sense to further select one down payment as multiple down payments concurrently would be illogic. Now a user can play around with the different visualizations, try different selections and brushing of data to find good insights. For example, a user may want to know the best locations for 2-bedroom apartments. First the user clicks on the 2-bedroom chart, then on the condo-chart, and from there on the down payment the highest annualized rate of return. Now the user can choose to further drill down with even more selections or evaluate the neighborhoods on the map.

4.1.5   Pop-up Information

All visualizations provide useful pop-up information when hovering over a line, polygon in the map, or bar on a chart. These messages include information such as the annualized rate of return, neighborhood, or any of the information that can be viewed or selection in the different charts.

4.1.6   Tables

The overview section also contains a separate dashboard with only tables but no visualizations. Given the business savvy audience of this project I found it helpful to provide additional numbers in data tables. Using these tables an analyst can easily and quickly compare multiple numbers across several neighborhoods.

4.2   Property Distribution

This section goes down to the lowest level of the data, the individual property.

4.2.1   Map

This map shows the distribution of all properties on a map with neighborhoods of Vancouver. Furthermore, the individual properties are color coded by number of bedrooms. It is therefore very easy to see any patterns of number of bedrooms within a particular area. Moreover, the user has the option of only showing properties for sale or all properties. Being able to see where certain properties are, gives the user an idea of where they should look for if they have a certain number of bedrooms in mind. For example, a user might want to live in a bachelor apartment in Killarney. However, once this user sees all the properties on the map in Killarney they will quickly realize that Killarney has mostly 2-bedroom apartments.

I initially intended to show these properties on the map of the previous overview dashboard. However, unfortunately I was not able to put 3 layers on top of each other on a map in Tableau. Furthermore, I reached the size limit on the previous dashboard and was therefore forced to put this map on a separate dashboard. Due to this restriction the user will miss out on some interactions, but they do have the ability to switch between the two dashboards.
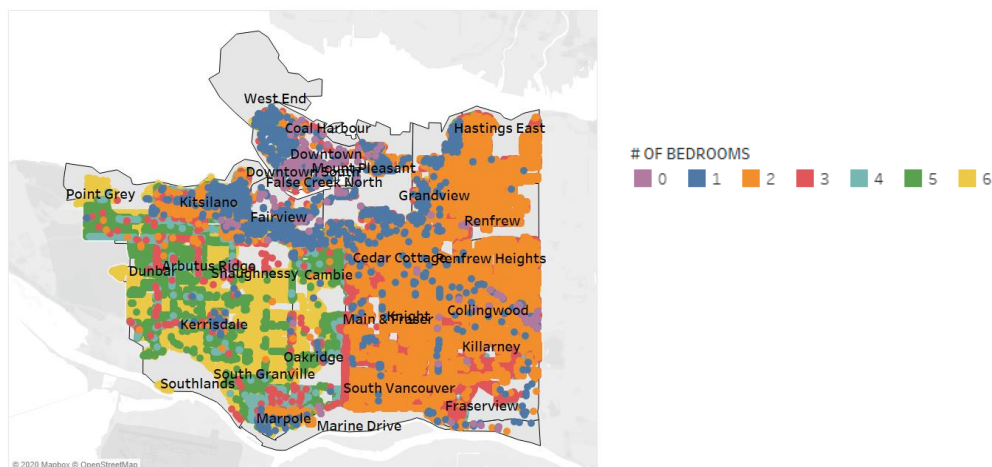
4.2.2 Table

Similarly, to the overview dashboard I added a data table. For an analyst it will be very helpful to see detailed number of properties as well as sales data for multiple neighborhoods in one table.

4.3 Choice of Colors

All colors including hues and saturation were chosen in consideration of visually impaired people. A check with (Check my Colors) determined that my color palettes and contrasts were appropriate for color blind people.

5 Further work

5.1.1 Stock Investments

This project did not use realistic investment strategies for true comparison as the stock returns are based solely on one stock. However, in reality investors would balance their investments and purchase various stocks as well as bonds or other money market tools. An option would therefore be to include multiple realistic investment portfolios.

5.1.2 ZIP Code

For the scope of this project I only included the neighborhood as the geographic dimension for the properties. However, being able visualize real restate performances by ZIP code would also be very useful.

5.1.3 Age of Property

The age of the real estate property is only visible when analyzing the artificial sales data. However, for a potential buyer having the opportunity to compare the property returns by the age of the building could be very vital. Because the data processing down to the age was too time consuming it was out of the scope of this project.

5.1.4 Detailed Sales Data

From an investment perspective it would be very helpful to inspect the current properties for sale more in detail to analyze their previous performances. With performance information up to the level of the individual property an investor would be able to acquire a lot of useful knowledge before making a purchase.

5.1.5 Selection of Individual Properties

Once more detailed information on properties for sale is available it would also be useful for an analyst to select multiple properties within a more selective area than a neighborhood or ZIP code. I would have liked to further implement the option to select all properties along a certain street or corner.

6   Feasibility Pilot

I asked a financial advisor to review my prototype. She had difficulties getting started which is why I added some quick instructions. However, due to the complexity a more detailed manual may be required. Furthermore, the logic behind the data is quite complex and not easily explained in 2 sentences. Another feedback was the she would like a more detailed analysis into the stock market. However, the scope of this project was to focus on real estate properties rather than stock market instruments.

7   User Manual

7.1   Overview

1. Mandatory: Select Year of Purchase
2. Mandatory: Select Year of Sale
3. Optional: Select Minimum Market Value
4. Optional: Select Maximum Market Value
5. Recommended: Select one or multiple neighborhoods
6. At any time during these steps, the annualized rate of return can be observed in the line plot next to the map of Vancouver.
7. Further selections
   a. A selection in the visualizations below the map and line plot can be made as follows
      i. Click either on header (below the title) of the chart or click on bar within the desired category.
8. Recommended: Select one down payment
   a. This is optional but analyzing returns with multiple concurrent down payments would be illogical.
9. Optional: Make single or multiple selections in the visualizations after Down Payment

7.2   Property Distribution

1. Optional: Select Minimum Market Value
2. Optional: Select Maximum Market Value
3. Optional: Select Minimum Building Age
4. Optional: Select Maximum Building Age
5. Optional: Select all or only properties on sale
6. Optional: Select all, multiple or a single value for # of Bedrooms

8 Unimplemented Sections of the Design

8.1.1 More Categories for Distribution of Properties

In addition to the number of bedrooms I would have liked to also show the distribution of other property categories on a map of Vancouver. Being able to see in which areas mostly condos or family dwellings are, as well as Strata vs Non-Strata would be valuable insights. However, given my limited time frame and the complexity of the current visualizations this implementation was not feasible.

8.1.2 Single Map for Annualized Rate of Return and Property Distribution

Due to the Limitations of Tableau I was not able to lay the property distribution with its 2 layers on top of another map with the return data.

8.1.3 Selection of Neighborhood in Overview

In the overview I would have liked to directly select the neighborhood in the various visualizations for down payment, legal type, etc. However, due to limitations in Tableau that was not possible as the filters from the different visualizations were conflicting with each other. Instead, there is a bar plot that also serves as the selection option for neighborhoods.

9 Conclusions

Given the interactions and how the prototype's visualizations work together, I believe this could be a powerful tool for an investor to determine whether they should buy a real estate property or invest their money in the stock market. This tool is able to give an investor a great overview of how different property categories performed in the past in the stock market, such as neighborhoods, # of bedrooms, Strata vs Non-Strata, Condo vs House, etc. Furthermore, an investor has also the opportunity to see the distribution of properties across the different neighborhoods in Vancouver. Along with the number of bedrooms it is also possible to view which properties are for sale which gives an investor a good idea of where they potentially could make a purchase given their choice of property type.

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